

Camden County Municipal Utilities Authority:

A Wet Weather Case Study of Incorporating Community Interests into Effective Infrastructure Decision-Making



Jurisdictions:

- City of Camden
- City of Gloucester
- Camden County



CCMUA: a county-wide public wastewater utility.

Wastewater System

<i>Residents served</i>	510,0000
<i>Lines</i>	125 mi.
<i>Plant capacity</i>	58 mgd



Receiving water: Delaware River



Revenues: ~\$100 million/annually



Average number of Combined Sewer Overflows annually: 70



LTCP required to be in place by 2020

CCMUA Goal: 2018

Executive Summary

The following case example describes the ways in which the Camden County Municipal Utility Authority (CCMUA), together with the U.S. EPA Office of Wastewater Management (OWM) and representatives from the community-based Camden SMART Initiative, used an augmented infrastructure alternatives analysis approach to help CCMUA identify an optimal and cost-effective mix of green and gray infrastructure to support its Combined Sewer Long-Term Control Plan (LTCP). The method used by CCMUA is designed to engage community stakeholders in the infrastructure alternatives analysis process at a very early stage. The method allows utilities and community members to use a range of environmental, social, and economic criteria (also known as “Triple Bottom Line” criteria) and create a broad basis for comparison of infrastructure alternatives.

By using this broad range of criteria to assess infrastructure alternatives, CCMUA was able to better understand the optimal mix of green and gray infrastructure necessary to protect the health of its citizens, consistent with a set of community goals agreed to by the Camden SMART stakeholders. With this method, utilities can accomplish internal infrastructure objectives and community goals as well as enhance their standing as an integral, engaged, and dynamic part of the economic and social fabric of the community.

Just as importantly, the approach described in this case example will help CCMUA communicate with their board members and other decision makers to ensure these individuals have a clear understanding of the choices before

them as they make the critical financial and policy decisions necessary to ensure the utility's infrastructure is sustainable over time. Finally, the approach described in this case example is transferable to other communities facing a myriad of infrastructure challenges.

EPA wishes to extend its appreciation to Andrew Kricun, Executive Director of the Camden County Municipal Utility Authority, his staff, and the dedicated members of the Camden SMART Initiative for their contributions that led to this case study.

Relationship to Integrated and Other Infrastructure Planning

This case study focuses on one important aspect of wet-weather challenges facing utilities and communities: Combined Sewer Overflows (CSOs). However, the methodology and process described are also relevant for communities facing other wet-weather challenges seeking to adopt an integrated planning approach to address these challenges (consistent with EPA's 2012 memorandum on integrated planning), as well as a full range of other infrastructure planning activities (e.g., long-range capital planning).

Integrated planning offers communities an opportunity to evaluate and incorporate sustainable, community-first solutions, such as the development of green infrastructure and meeting water quality and human health goals in a cost-effective manner that sustains our nation's essential water infrastructure and creates jobs to strengthen the local economy.

Camden County Municipal Utilities Authority: Project Background

In 2015, the Camden County Municipal Utilities Authority began a proactive effort to develop a watershed-wide LTCP to address aging infrastructure and an overloaded combined sewer system for the cities of Camden and Gloucester, New Jersey. CCMUA aimed to use the LTCP development process as an opportunity to meaningfully incorporate the needs and values of the community into its infrastructure decision-making. In addition, CCMUA hoped to improve the region's Triple Bottom Line sustainability and overall resiliency through infrastructure investments.

Community Characteristics

Camden is the largest city in Camden County, New Jersey, and is situated directly across the Delaware River from Philadelphia, Pennsylvania. The smaller city of Gloucester is immediately south of the City of Camden. Historically, this area has experienced wide disparities in income and poverty rates, with the City of Camden typically ranked as the poorest city in the State of New Jersey. The wastewater systems for both cities connect to the regional interceptor system and treatment facility operated by CCMUA, a unit of the Camden County government.



U.S. EPA Partners with CCMUA

The U.S. Environmental Protection Agency (EPA) Office of Wastewater Management was aware of the forthcoming effort to prepare the LTCP in New Jersey, and offered to partner with the three jurisdictions in support of a test case for a recently developed alternatives analysis methodology, which incorporates Triple Bottom Line criteria into infrastructure decision-making processes. The analytical method uses community priorities to create a structure for decision-making and offers a process for engaging community stakeholders to objectively evaluate a range of infrastructure and/or operational options; the partnering stakeholder sought to test the method's value to utilities in a real-world setting.

The Problem: Combined Sewer Overflows (CSOs)

Like many aging urban centers in the U.S., Camden’s sewer system manages both wastewater and stormwater in a single network of pipes. Every day, the system carries wastewater to the regional treatment plant operated by CCMUA. When it rains, the pipes fill with runoff from the city and this stormwater runoff combines with untreated wastewater in the system. During heavy rain events, the pipes and treatment plant cannot handle the combined volume of water, sometimes causing overflows to occur. In Camden, CSOs of untreated wastewater and stormwater can discharge directly into rivers and streams. In some neighborhoods, the untreated water floods city streets and parks and backs up into residents’ homes and basements. Not only does this create a nuisance for the community, it is a public health concern that can adversely affect the quality of life of Camden’s residents and negatively impact the region’s economic viability and environmental quality.

Need for a Long-Term Control Plan (LTCP)

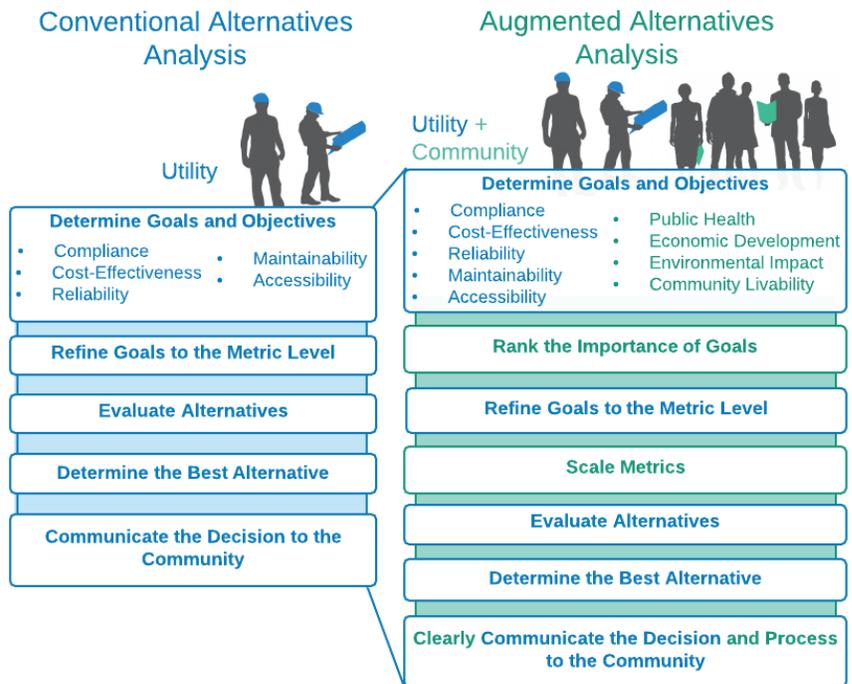
In an average year, the Camden wastewater system experiences approximately 70 combined sewer overflow events. Under its current CSO policy, EPA expects a municipality to reduce CSO occurrences to four overflow events (or fewer) in a typical year.

To address the CSO problem in the Camden area, the Cities of Camden and Gloucester engaged CCMUA as the entity to prepare a watershed-wide LTCP. CCMUA knew that any LTCP decision would involve large, long-term financial commitments and infrastructure investments that would influence the economic, social, and environmental sustainability and resiliency of the community. Though the LTCP was not required to be completed until 2020, CCMUA decided to accelerate the completion of its LTCP to 2018 to eliminate combined sewage flooding and combined sewage overflows in Camden as quickly as possible. From the onset of the LTCP planning process, CCMUA wanted meaningful engagement with the communities of Camden County, the City of Camden, and the City of Gloucester around the infrastructure options available to meet the goals of an LTCP.

How Does the Process Used in Camden Augment Conventional Alternatives Analysis?

In conventional alternatives analysis, utilities typically focus on criteria based on technical performance (e.g., whether the alternative supports meeting a regulatory endpoint such as a technology or water quality discharge standard) and the cost of doing so (i.e., the present value of the full life-cycle costs of the alternative), along with other important technical and operational criteria such as reliability, maintainability, and accessibility.

These criteria are important, and the augmented process used in Camden does not discount this importance, but rather it adds to the core concepts of alternatives analysis in a few key ways:



- Facilitates the use of additional environmental, economic, and social criteria and allows for comparability across otherwise dissimilar criteria.
- Provides a supplementary step between analysis and output to help utilities communicate clearly with community stakeholders and substantively engage them in the process of identifying potential infrastructure alternatives.
- Helps utilities who may have difficulty determining the best way to incorporate specific community input into the decision-making processes. Accordingly, it closes the gap between intentions and ability to incorporate community feedback by providing a step-by-step structure to accomplish that objective.

Camden’s Stakeholder Engagement and LTCP Development Process

In early 2016, CCMUA, together with the U.S. EPA Office of Wastewater Management, New Jersey Department of Environmental Protection (NJDEP) and the Camden SMART Initiative, formed a Workgroup and held an initial in-person meeting to discuss the needs, concerns, and values of the community. Together, the Workgroup tackled the first step in the process: goal setting.

The Workgroup used the augmented alternatives analysis process to expand their consideration of the range of benefits that can result from an LTCP. Due to frequent CSOs in the area, the Workgroup felt that protecting neighborhoods from untreated water and street flooding was a top priority. With CCMUA’s encouragement, the Workgroup considered regulatory requirements, such as water quality criteria, as the baseline (or floor) for future performance. Workgroup members began to discuss what the ideal future state would look like: **exceeding requirements and proactively protecting the health and environment of the community**. With community benefits and needs at the center of the discussion, the Workgroup identified the six following goals for the LTCP:



The Camden SMART Initiative

The Camden Stormwater Management and Resource Training (“SMART”) Initiative is a community-driven movement to protect human health, improve conditions for economic development, improve water quality, and enhance the quality of life for Camden residents. The partnership includes six community organizations including local and state governments, community non-profits, and academic organizations. Importantly, the initiative focuses on the use of both green and gray infrastructure techniques for stormwater management.

Figure 1: Camden’s LTCP Goals



Some of Camden’s goals, such as Meet or Exceed Permit Requirements, are typically considered in a conventional alternatives analysis. Others, such as Enhance Public Health and the Environment, go beyond the conventional scope of goals and embody the desire of the Workgroup to evaluate alternatives against their ability to achieve a state of public health and environment above levels dictated by regulatory requirements. EPA’s method provided the community a systematic means to use compliance as starting point on which to improve even further.

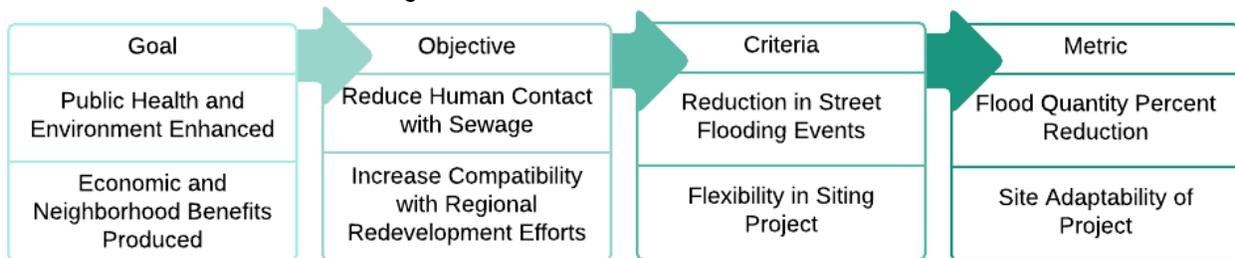
Once the goals were established, the Workgroup ranked the importance of each goal according to the supplementary step in EPA’s augmented process. By ranking goals, the Workgroup was able to further guide the alternatives analysis to reflect the needs and strength of preferences of Camden and the surrounding areas.

The Workgroup determined that “Enhance Public Health and Environment” was the most important goal and was given a 10 weight. Each consecutive goal was then ranked according to its importance relative to “Enhance Public Health and Environment.” As such, any alternative under consideration that met this goal had the potential to receive a higher score than alternatives that did not offer enhanced public health and environment performance.

Weighted Goals	
10	Enhance Public Health and Environment
9	Meet or Exceed Permit Requirements
8	Enhance Overall System Resiliency
8	Produce Economic and Neighborhood Benefits
7	Optimize Existing Public Resources
6	Increase Public Understanding and Support for Combined Sewer Overflow (CSO) Solutions

At the second in-person meeting held in June 2016, the Workgroup further refined how they would measure each alternative’s performance relative to LTCP goals by establishing criteria and metrics for each goal. Criteria provide the basis for evaluation while metrics provided a specific unit that can be used for measurement. See Figure 2 for an example of how two goals were refined to the metric level. For a full list of the goals, objectives, criteria, and metrics, see the Scoring Table in Attachment A.

Figure 2: Goals Refined to the Metric Level



Once goals had been refined down to the metric level, the Workgroup needed a way to compare very different types of measurements, such as flood quantity percent reduction and site adaptability of a project. The collaboratively developed method provided the Workgroup with a scaling framework that supports comparability between dissimilar metrics. To scale, the Workgroup first determined the current state of performance and assigned that performance a “0” on the scale. Next, the highest and lowest possible performance outcomes were identified and assigned a +5 and -5 value respectively. For metrics in which negative outcomes would be unacceptable, such as an increase in flood quantity, the Workgroup created a 0 to +5 scale. The Workgroup then filled in the interim performance outcomes and created a numerical scale for each metric. See Figure 3 for an example of scaling for the metrics in Figure 2.

Figure 3: Scaled Metrics

Flood Quantity Percent Reduction (positive only)										
-5	-4	-3	-2	-1	0	1	2	3	4	5
					Alternative has no impact on the flood quantity	Alternative reduces flood quantity by 10% annually	Alternative reduces flood quantity by 20% annually	Alternative reduces flood quantity by 30% annually	Alternative reduces flood quantity by 40% annually	Alternative reduces flood quantity by 50% annually
Increase Compatibility with Regional Redevelopment Efforts										
-5	-4	-3	-2	-1	0	1	2	3	4	5
					Alternative has no site adaptability	Alternative has low site adaptability		Alternative has moderate site adaptability		Alternative has high site adaptability

Camden’s Sewershed Alternatives Analysis

Once the Workgroup had established a common scale by which to compare performance uniformly, CCMUA undertook a pilot test of the methodology and the stakeholder group met for a third time in February 2017 to review the results. At the time of the final Workgroup meeting, CCMUA was in the initial development phase of the LTCP and the alternatives, modeling, and evaluation were conducted as a proof of concept, rather than as a full-scale analysis conducted at the detailed alternatives evaluation phase. To conduct this proof of concept analysis, CCMUA first identified two sewersheds: C-11 and C-32. For these sewersheds, CCMUA and a third-party engineering consultancy evaluated a set of selected alternatives using the scaled metrics and scored each alternative based on its projected performance. To demonstrate the application of the augmented alternatives analysis process, this case study focuses on C-32 only. For more information on the analysis of alternatives in Sewershed C-11, see the textbox below.

Sewershed C-32 is a highly residential neighborhood in Camden with a land area of 491 acres. Of the total land mass, 43% (211) is impervious area. C-32 experiences an average of 57 overflows during a typical year and these overflows result in roughly 152 million gallons of overflow volume during a typical year. Due to the residential nature of the sewershed and the high frequency of flooding events, CCMUA chose this sewershed as an ideal candidate to test the performance of a set of alternatives.

CCMUA conducted a sewershed site analysis for C-32 and assessed other urban CSO programs to determine the realistic bounds for impervious area reduction using green infrastructure. CCMUA identified three viable alternatives for consideration with three distinct levels of green/gray technologies which would each result in equivalent levels of CSO control:

- **Alternative A:** All Gray (0% Impervious Reduction)
- **Alternative B:** Moderate Green (10% Impervious Reduction)
- **Alternative C:** Heavy Green (35% Impervious Reduction)

To conduct this proof of concept exercise at this phase of the LTCP process, CCMUA made the following simplifying assumptions:

- The infrastructure alternatives were analyzed at the sewershed level and not evaluated on a system-wide scale, and due to the system-wide nature of some metrics (e.g., improved maintenance of Camden collection system), the exercise used 9 of the 20 metrics, which represented a full spectrum of environmental, economic, and social outcomes, to evaluate the performance of the alternatives.
- Certain types of gray infrastructure, such as conveyance or sewer separation, were not evaluated due to the site-specific nature of their effects and the need to evaluate the impacts at a multi-sewershed, basin-wide, and/or system-wide level of analysis. CCMUA decided to consider two types of gray technologies for comparison in the sewershed assessment: (1) storage and slow release; and (2) treatment in satellite facilities.
- Cost estimates were established using basic planning level estimates; Association for the Advancement of Cost Engineering (AACE) Level 4 (-30% to +50% accuracy range).

Next, CCMUA modeled each of the three alternatives identified above and measured their performance. To accurately score, all three alternatives were evaluated against each metric. As shown in Figure 4, Alternative C was estimated using best professional judgment by CCMUA to reduce flood quantity by 30% annually in C-32. For this reason, Alternative C received a 3 for this metric. This score was then multiplied by the weight of 10 assigned to the goal, "Enhance Public Health and Environment." Figure 5 shows the final score of 30 for Alternative A. Each alternative was measured using this framework, and the final, weighted scores for each are listed in Figure 5.

Figure 4: Alternative C Scoring Example

Flood Quantity Percent Reduction (positive only)										
-5	-4	-3	-2	-1	0	1	2	3	4	5
					Alternative has no impact on the flood quantity	Alternative reduces flood quantity by 10% annually	Alternative reduces flood quantity by 20% annually	Alternative reduces flood quantity by 30% annually	Alternative reduces flood quantity by 40% annually	Alternative reduces flood quantity by 50% annually

In this exercise, Alternative C: Heavy Green (35% Impervious Reduction) was the preferred alternative in C-32 as it received the highest score. This result indicates that of all three alternatives, Alternative C had the highest estimated performance outcomes based on the criteria the Workgroup identified as important to the community.

Sewershed C-11

Sewershed C-11 contains the commercial core of Camden and is the site of a major redevelopment effort scheduled to begin in Fall 2017. In contrast to the residential makeup of C-32, CCMUA chose C-11 to test the augmented alternatives analysis in a dense, highly commercial area. Using a 2016 site analysis conducted by the Rutgers New Jersey Agriculture Experiment Station, it was determined that 15.2 acres, or 12%, was the upper bound of the impervious removal rate in C-11. For this reason, CCMUA measured the performance of two alternatives in C-11:

- **Alternative A:** All Gray (0% Impervious Reduction)
- **Alternative B:** Moderate Green (12% Impervious Reduction)

The process used in C-11 follows the same steps detailed below for C-32: score performance, weight scores, and identify the alternative with the highest final score. This exercise demonstrated that the methodology created a robust and standard framework by which to judge the performance of each of the identified alternatives. See Appendix C for final scores for Alternatives A and B in C-11.

Figure 5: C-32 Final Scores

Criteria	Weighted Score		
	Alternative A	Alternative B	Alternative C
1.A.i – Reduction in flooding events	0	10	30
1.B.i. - Reduction in CSO discharge volume	40	40	40
2.A.i – Annual system-wide CSO volume capture	45	45	45
4.A.i – Flexibility in siting project	8	8	8
4.A.ii – Flexibility in timing of implementation of project	32	24	16
4.A.iii – Flexibility in phasing implementation of alternatives	24	24	24
4.B.i. – Green space	0	8	8
4.B.ii – Reduction in heat island effect	0	8	8
5.A.i – Cost effectiveness	14	-7	-21
6.A.i – Visibility to citizens and opp. to present educational materials	6	18	30
TOTAL	169	178	188

After reviewing the scores, the Workgroup discussed the outcomes of the evaluation exercise. By incorporating specific community values and broadening the type of values considered, the augmented steps allowed alternatives with the greatest portfolio of benefits to compete, even though those alternatives may be more cost-intensive to implement. Additionally, the augmented process created a structured format for CCMUA to communicate the results of its technical modeling and analysis. Though the Workgroup was comprised of stakeholders with varying levels of technical expertise, all Workgroup members reported that the decision-making process was accessible and transparent and allowed them to provide meaningful and timely input.

Next Steps in Camden

The work with CCMUA confirmed that the approach used was technically and methodically sound throughout. For example, the work demonstrated that the scaling method for the criteria did allow for uniform comparability across otherwise dissimilar metrics. However, since this exercise was conducted at the initial development phase of the LTCP, the final scoring of the alternatives may change at the detailed analysis phase of the LTCP process. The specifics of each alternative may also be modified as CCMUA further refines the infrastructure options available.

Although both the alternatives and the scoring may be modified as CCMUA moves into the detailed analysis phase, the framework used to evaluate and score those alternatives developed by the Workgroup and used in the exercise above will remain the same. Over the next two years, CCMUA will model the alternatives at a sewershed level and will evaluate the performance of alternatives against all 20 of the metrics identified by the Workgroup.

Benefits Associated with the Process Used in Camden

Incorporated a Wider Range of Benefits for Consideration

When developing control plans for CSOs or other wet-weather events, infrastructure alternatives analysis methods used by utilities often focus on technical performance and cost. With the augmented process, the full range of community benefits - social, environmental, and economic (including costs reduction) - were considered and incorporated into the analysis in a systematic and replicable way. Due to the context of frequent CSOs, CCMUA's Workgroup determined that enhanced public health was the highest priority for their community. By creating the Scoring Table with public health as the highest priority goal, alternatives that would provide these benefits were able to compete against alternatives that would score higher in a traditional cost-effectiveness evaluation focused on regulatory compliance endpoints.

Allowed the Utility to Effectively Engage Community Stakeholders in the Discussion

The augmented process did not replace the modeling and analysis conducted by CCMUA and its engineering teams; instead it provided tools that translated the technical results of this work into a format accessible to the community. Each step in the process required an explicit articulation of its rationale, which prepared both the utility and the community members to engage in a discussion with an increased specificity about why certain decisions were made. For example, near the end of the process, one community member questioned the decision to place public health as the most important goal. Because of the transparent nature of the goal-setting and scoring process, both the utility staff and community members were able to articulate the Workgroup's thought process and the conversation that led to the decision.

Closed the Gap Between Intentions and Ability to Incorporate Community Values as an "Anchor Point"

CCMUA was able to build trust with the community by incorporating community values into the publicly-stated goals of the LTCP. Those goals created a structure for the scoring system for comparing alternatives. Even though the goals, weights, and the scales for measuring alternatives were debated extensively, the structure created a uniform measurement by which each alternative was judged. Once the Workgroup agreed to the framework and process, there was general agreement that the final scores were valid. By explicitly demonstrating the impact of community values on the evaluation and scoring of alternatives, CCMUA was able to close the gap between the intention to incorporate community feedback and an effective and transparent structure to accomplish that outcome.

Take-Away Messages

The augmented alternatives analysis process used in Camden can provide utilities with a clear, structured process for engaging stakeholders and broadening the analysis to systematically and replicably incorporate a wider range of benefits into infrastructure investments, whether they be for CSOs, other wet weather challenges, or infrastructure planning in general. As demonstrated in this case study, utilities are able to use this methodology in concert with the conventional technical analysis. The methodology creates a common ground on which utilities and their communities can communicate with each other in a clear and accessible format to find affordable and effective solutions for their residents.

"I think the approach is very transferable to any utility to address wet-weather issues in an integrated fashion including, but not limited to, areas with combined sewers like Camden. The work in Camden lends itself to more opportunities to consider when working with other communities.

--Andy Kricun, P.E., Executive Director/

This process is also well-suited for other situations where communities are in the process of developing integrated plans to address multiple wet weather issues in vulnerable watersheds. For more information on this augmented process and how to apply it to your program, see the *Making the Right Choices for Your Utility: Using Sustainability Criteria for Water Infrastructure Decision Making* guidance located at www.watereum.org.

Attachment A: Scoring Table

Goals	Objectives	Criteria	Metric
1. Public Health and Environment Enhanced Weight = 10	1.A Reduce human contact with sewage	1.A.i. Reduction in street flooding events – emphasis on residential areas	1.A.i.a flood quantity % reduction (positive only), discern high residential area impacts
	1.B Improve receiving water quality	1.B.i Reduction in CSO discharge volume	1.B.i.a System wide total capture %
2. Permit Requirements Met or Exceeded (Water Quality Protected) Weight = 9	2.A Meet/exceed capture targets	2.A.i Annual system-wide CSO volume capture	2.A.i.a % Annual capture relative to baseline (positive only)
	2.B Meet/exceed treatment targets	2.B.i Treatment target exceedance	2.B.i.a % Over treatment target
3. Overall System Resiliency Enhanced Weight = 8	3.A Increase resilience to storm surges	3.A.i Ability to sustain storm surge and other flood events without significant structural or functional damage	3.A.i.a CSO control facilities can withstand the ____ year (e.g. 500 year) storm surge and other flood events without structural or equipment damage that would preclude operation after the storm or flood
	3.B Increase adaptability to changing hydrologic conditions	3.B.i Adaptability to maintain design performance with consideration for future design storm conditions	3.B.i.a CSO Control facilities can be designed with ability to increase design capacity to accommodate future storm conditions as projected by agencies such as IPCC, USEP, and NJDEP
4. Economic and Neighborhood Benefits Produced Weight = 8	4.A Increase compatibility with regional redevelopment efforts	4.A.i Flexibility in siting project	4.A.i.a Site adaptability of project
		4.A.ii Flexibility in timing implementation of alternatives	4.A.ii.a Performance contribution weighted lead time ¹
		4.A.iii Flexibility in phasing implementation of alternatives	4.A.iii.a Scalability potential (rated by minimum, technically and financially viable performance level in gallons managed) ²
	4.B Improve livability in neighborhoods	4.B.i Green space	4.B.i.a Area of green space in acres 4.B.i.b Area of recreational space in acres
		4.B. reduction in heat island effects	4.B.ii.a Area of tree canopy cover in square feet

¹ Example: An alternative meet 10% of CSO reduction volume through Green infrastructure, 60% with WWTP improvements, 30% with conveyance enhancements: Green Infrastructure – 5-year average lead time for implementation * 0.1 = 0.5; WWTP Improvements – 10 years lead time for implementation * 0.6 = 6.0; Conveyance – 7 years of lead time for implementation * 0.30 = 2.1; Weighted average lead time = 8.6 years

² Scalability Potential reflects that the ability to phase alternatives will have value when uncertainty exists about 1) the performance of initial investments, 2) treatment demand from population/economic growth/decline, and/or 3) future wet weather conditions (e.g., more, more intense storms; fewer and lower intensity storms). The scalability of an alternative is key to its ability to support phasing – the lower the level of technical and financial performance viability, the more scalable an alternative will be. For example, a deep tunnel for storage has a higher minimum technical and financial performance viability level than high velocity side-stream treatment, thus side-stream treatment has greater Scalability Potential.

Goals	Objectives	Criteria	Metric
		4.B.iii Reduction in underdeveloped/vacant properties	4.B.iii.a Acres of underdeveloped/vacant properties converted
5. Existing Public Resources Optimized Weight = 7	5.A Identify and establish an affordable CSO strategy based on full lifecycle cost (identify best value project alternatives)	5.A.i Cost effectiveness	5.A.i.a Least present worth cost (for this exercise)
		5.A.ii Wastewater (and stormwater) costs <2% of Median Household Income upon full implementation of LTCP	5.A.ii.a Annual wastewater and stormwater costs for a typical residential user as a percentage of Camden MHI
	5.B Reduce the amount of stormwater and groundwater entering system	5.B.i Source reduction volume	5.B.i.a Million gallons of flow removed (Positive only)
	5.C Support ongoing collection system operations	5.C.i Increase in annual collection sewer rehab or replacement	5.C.i.a Length of rehab/replacement (Positive only)
		5.C.ii Improved maintenance of infrastructure	5.C.ii.a Percent of pipe inch-miles and catch basins cleaned annually (after current initial 3-year remedial program)
6. Public Understanding and Support for CSO Solutions Weight = 6	6.A Transfer knowledge of CSO problems and value of wastewater services	6.A.i Visibility to citizens and opportunity to present educational materials (design, construction, operation)	6.A.i.a H, M, L ranking for visibility and opportunity
		6.B.i Multi-use nature of infrastructure and degree of access (operation)	6.B.i.a H, M, L ranking for multi-use and accessibility

Attachment B: Sample Scaled Metrics for C-32

Goal 1: Public Health and Environment Protected

Objective 1.A.: Reduce human contact with sewage											
Criteria 1.A.i: Reduction in street flooding events – emphasis on residential areas											
Metric 1.A.i.a: flood quantity % reduction (positive only), discern high residential area impacts											
Scoring	-5	-4	-3	-2	-1	0	1	2	3	4	5
						Alternative has no impact on the flood quantity	Alternative reduces flood quantity by 10% annually	Alternative reduces flood quantity by 20% annually	Alternative reduces flood quantity by 30% annually	Alternative reduces flood quantity by 40% annually	Alternative reduces flood quantity by 50% annually
Alternative A: All Gray											0
Alternative B: Moderate Green											1
Alternative C: Heavy Green											3

Objective 1.B.: Improve receiving water quality											
Criteria 1.B.i: Reduction in CSO discharge volume											
Metric 1.B.i.a: System wide total capture %											
Scoring	-5	-4	-3	-2	-1	0	1	2	3	4	5
						Alternative has no effect on the annual discharge volume	Alternative decreases discharge volume by 10% annually	Alternative decreases discharge volume by 20% annually	Alternative decreases discharge volume by 30% annually	Alternative decreases discharge volume by 40% annually	Alternative decreases discharge volume by 50%+ annually
Alternative A : All Gray											4
Alternative B : Moderate Green											4
Alternative C : Heavy Green											4

Goal 2: Permit Requirements Met or Exceeded (Water Quality Protected)

Objective 2.A: Meet/exceed capture targets											
Criteria 2.A.i: Annual system-wide CSO volume capture											
Metric 2.A.i.a: % Annual capture relative to baseline (positive only)											
Scoring	-5	-4	-3	-2	-1	0	1	2	3	4	5
						Alternative has no impact on the % annual capture	Alternative increases % annual capture quantity by 10% annually	Alternative increases % annual capture by 20% annually	Alternative increases % annual capture by 30% annually	Alternative increases % annual capture by 40% annually	Alternative increases % annual capture by 50%+ annually
Alternative A: All Gray										5	
Alternative B: Moderate Green										5	
Alternative C: Heavy Green										5	

Goal 4: Economic and Neighborhood Benefits Produced

Objective 4.A: Increase compatibility with regional redevelopment efforts											
Criteria 4.A.i: Flexibility in siting project											
Metric 4.A.i.a: Site adaptability of project											
Scoring	-5	-4	-3	-2	-1	0	1	2	3	4	5
						Alternative has no site adaptability	Alternative has low site adaptability		Alternative has moderate site adaptability		Alternative has high site adaptability
Alternative A: All Gray										1	
Alternative B: Moderate Green										1	
Alternative C: Heavy Green										1	

Attachment C: C-11 Final Scores

Criteria	Weighted Score	
	Alternative A (All Grey)	Alternative B (Moderate Green)
1.A.i – Reduction in Flooding Events	0	0
1.B.i. - Reduction in CSO Discharge Volume	10	10
2.A.i – Annual System-Wide CSO Volume Capture	9	18
4.A.i – Flexibility in siting project	8	8
4.A.ii – Flexibility in timing of implementation of project	40	40
4.A.iii – Flexibility in phasing implementation of alternatives	24	24
4.B.i. – Green Space	0	8
4.B.ii – Reduction in heat island effect	0	8
4.B.iii. – Reduction in underdeveloped/vacant properties	0	35
5.A.i – Cost Effectiveness	0	-14
6.A.i – Visibility to citizens and opportunity to present educational materials	6	30
TOTAL	<u>97</u>	<u>167</u>